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A BRIEF SKETCH OF ONE OF BALTIMORE'S GREATEST MEN

HORATIO GATES JAMESON, M.D.

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A BRIEF SKETCH OF ONE OF BALTIMORE'S GREATEST MEN

HORATIO GATES JAMESON, M.D.

HIS MOST VALUABLE CONTRIBUTION TO SURGERY: THE OCCLUSION OF ARTERIES BY THE BURIED ANIMAL LIGATURE

BY

HENRY O. MARCY, A.M., M.D., LL.D.
BOSTON
SURGEON TO THE CAMBRIDGE HOSPITAL FOR WOMEN; LATE PRESIDENT OF THE AMERICAN MEDICAL ASSOCIATION; PRESIDENT OF THE SECTION ON GYNECOLOGY, NINTH INTERNATIONAL MEDICAL CONGRESS; LATE PRESIDENT OF THE AMERICAN ACADEMY OF MEDICINE; MEMBER OF THE BRITISH MEDICAL ASSOCIATION; MEMBER OF THE MASSACHUSETTS MEDICAL SOCIETY; MEMBER OF THE BOSTON GYNECOLOGICAL SOCIETY; CORRESPONDING MEMBER OF THE MEDICO-CHIRURGICAL SOCIETY OF BOLOGNA, ITALY; LATE SURGEON, U. S. A., ETC.

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HIS MOST VALUABLE CONTRIBUTION TO SURGERY: THE OCCLUSION OF ARTERIES BY THE BURIED ANIMAL LIGATURE.

By Henry O. Marcy, M.D.,
Boston.

The small army of investigators today are so intent upon their studies and the profession at large so interested in their results, that most of us forget the painstaking research work performed by equally acute observers in the past.

Many of the more valued observations of the present were carefully outlined, and in a measure executed, at periods so long ago that they have now been forgotten. It remains for the historian in medicine to properly make record of the splendid achievements of the past by men whose names are unknown to the present generation. I have often wondered that this fruitful field has been so sadly neglected; quite as much to the detriment of the present as to the lack of respect which is due our predecessors. Owing to the brilliant triumphs of science, during the last generation, medical research work was greatly neglected until the recent past and now we bespeak for it, in the light of new investigations, an interest and profit equal to, if not surpassing, that of surgery. I will be pardoned a single illustration. When a student in Berlin, in the early seventies, I became greatly interested in the studies of Wounderlitch upon fevers.

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I brought with me, upon my return to Boston, a number of clinical thermometers which I gave to medical friends. So far as I then knew they were the first used in America.

It may be known to some of you that Dr. Currie,[1] in 1797, invented clinical thermometers, even with registers, which for a considerable time were used in England.

Recently, I chanced to find an essay which was awarded a prize, in 1819, by the Boylston Medical Society of Boston, written by Dr. Enoch Hale, Jr., member of the Massachusetts Medical Society, in which he records a series of very careful observations to prove the absorption of drugs by intravenous injection. Boylston Prize Essay, 1821—"Dissertation on the Propriety of Injecting Medicinal Substances into the Veins." The interesting thing here to note is his careful observation of temperature taken under the tongue by the use of a clinical thermometer.

To our beloved Lord Lister, of England, is generally accorded the honor of introducing to the surgical profession the use of the animal ligature for the occlusion of arteries. His research work in this direction is more or less familiar to every student of modern surgery. The value of his contributions to surgery can hardly be overestimated. They are fundamental and revolutionary, and every practitioner of surgery in the civilized world is under a daily debt of gratitude to this most distinguished of living surgeons. But for this basic knowledge of bacterial infections, and how to avoid them, his studies upon the occlusion of arteries would necessarily be of comparatively minor value.

Even Mr. Lister, a man of wide erudition and research, was entirely ignorant of the work of a predecessor in this field, to whom now I have the honor of calling your attention. This was the more natural, since I suppose today our English friends will admit that they earlier shared with Sidney Smith in the feeling which he expressed when he satirically asked, "Who reads an American book?"

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[1] James Currie, born 1756, died 1806.

In this goodly city of Baltimore, in the early period, there lived a surgeon who is entitled to monumental distinction and enduring fame, Dr. Horatio Gates Jameson. He was a surgeon of distinction, although, of course, a general practitioner of medicine. His publications were not numerous, as adjudged by a modern standard, but he wrote an admirable treatise upon fevers, a book upon *Domestic Medicine*, and was the editor of a medical journal for years. His conclusions were quite at variance with the accepted teachings of the day, but re-read in the light of our present knowledge would be considered fundamental and orthodox.

The sources of information, of a man so famous, are extremely meagre, although men still living have him in memory. Our late friend, Dr. Gross, of Philadelphia, was for a time his junior assistant, and Dr. Gouley, of New York, has recently written me, in an interesting way, of his personal remembrances of Dr. Jameson.

One of the more recent and most interesting of medical publications is entitled *The Medical Annals of Maryland*, by Dr. Eugene F. Cordell, of Baltimore. I have availed myself of its pages in the preparation of this article.

Few men did so much to give credit to early American surgery as Dr. Horatio Gates Jameson, who from 1820 to 1840 carried the fame of Baltimore, as a seat of medical and surgical research, to all parts of the civilized world. This truly great surgeon was a native of York, Pa., where he was born, in the year 1778. His father, David Jameson, also a physician, had a most interesting and adventurous career. A native of Scotland and graduate as Doctor of Medicine at the University of Edinburgh, he emigrated to Charleston, S. C., in 1740. He was accompanied on the voyage by Dr. Hugh Mercer, who settled at Fredericksburg, Va., and became a Brigadier-General in the Continental army, losing his life, as is well known, at the battle of Princeton, in 1777. Dr. David Jameson also removed from Charleston and settled at York, Pa.; he died at Shippensburg in the same State, about the close of the century. He was a Lieutenant-Colonel in the French and Indian war and was badly wounded during that period in an engagement with the Indians. During the revolution he was Colonel of the third battalion of York County Association. In 1842 the son gave a charming description of his home at York, in a Baltimore periodical; also an account of his father's voyage across the Atlantic, describing among its hardships the short allowance of musty bread and foul water and the rusty salt beef doled out, yet consumed by crew and passengers with avidity.

Dr. H. G. Jameson studied medicine under his father and began practice, in 1795, at the early age of seventeen.

During the war of 1812 he held the office of surgeon to the United States troops at Baltimore, for which service his widow received a pension after his death.

He was physician to the city jail for several years; from 1814 to 1835 he was surgeon to Baltimore Hospital, and from 1821 to 1835 he was consulting physician to the Board of Health.

In 1830, on special invitation, he visited Europe, sailing by the packet running from Baltimore to Germany, and read before the medical section of the Society of German Naturalists and Physicians, which met in September of that year at Hamburg, a paper on the "Non-contagiousness of Yellow Fever." He was the only American delegate on this occasion and the first American to attend these meetings and felt deeply the honor of his position. His paper was read in translation at the meeting and was published on his return, in his journal. During his brief stay of two months in Europe he travelled through various European countries, staying longest at Copenhagen, to the American representative at which city he bore despatches from our government at Washington.

In 1835, while on his return from Texas, where he had purchased lands, he received and accepted an offer of a chair and presidency in the Ohio Medical College, at Cincinnati. His colleagues there were Drs. Gross, Drake, Rivers, and J. B. Rogers, the last his late colleague at Baltimore. He removed thither with his family in October, 1835, and lectured during the ensuing session.

During a visit to New York he was taken suddenly ill and died August 24, 1855, aged seventy-six years. His remains were brought back to Baltimore and interred in the Baltimore cemetery, corner of Gay Street and Boundary Avenue.

Dr. Jameson was about five feet ten inches in height, well built, erect, and muscular, but not corpulent; his head was covered with a sufficiency of snow-white hair; his face was always clean shaven, his complexion florid and healthy; his eyes dark brown and piercing and surmounted by bushy eyebrows; his face remarkably smooth and free from wrinkles. He retained his strength and power of endurance to the last. He wore heavy—remarkably heavy—gold spectacles. He dressed in black, wore a black tie, and was very careful and neat in his appearance—no one ever saw him look untidy. He spoke German, and was noted for his mechanical ingenuity.

Dr. Gross mentions him as particularly conspicuous in devising procedures for the radical cure of hernia. His operation of amputation of the cervix uteri for scirrhus, performed in May, 1824, has been referred to. It was the first done in Great Britain or America, but had been done in Europe by Oslander in 1801, and Lisfranc in 1816. It was Jameson's intention, in this case, to perform a vaginal hysterectomy. From the normal mobility of the uterus he believed he would be able to draw the uterus down low enough to enable him to pass a ligature behind it by means of a double cannula and wire. But he failed to get his toothed forceps into the uterine cavity, or to even get a curved needle armed with a ligature through the indurated cervix, and had to be content with pulling upon the vagina with tenacula and thus bringing the os into view.

The object of my calling attention to his teaching at this time is to emphasize the value of a medical prize essay, entitled "Observations upon Traumatic Hemorrhage, Illustrated by Experiments upon Living Animals," *Medical Recorder*, Philadelphia, 1827, vol. xi. He takes for his text a quotation from John Bell, then perhaps the highest surgical authority:

"Is not this fear of hemorrhage always uppermost in the minds of young surgeons? Were this one danger removed he would go forward in his profession almost without fear."

Dr. Jameson reviews, with much care, the teaching of the period and its great masters. He makes an especial emphasis upon the anatomical differences of the arteries, veins, and lymphatics, and shows that tissue arterial, when obliterated, is absorbed leaving *in situ* only connective-tissue cells. "Thus, when we tie an artery its contractile power is exerted in bringing the sides inward, which lessens the calibre, and, pressing the coats firmly against each other, there is considerable resistance to the deposition of lymph between them and the inner surface, a small distance from the ligature, as well as under it is brought into contact by the ligature, and thereby the fullest effect is given to the first effusion of lymph to produce a union of the walls; besides, we may reasonably suppose that the artery supplied with the blood, in its fullest formative powers, will heal better than if filled with blood, deteriorated, as it is in the veins. On the other hand, a vein having no contractile power lies flaccid when tied on that side of the ligature nearest to the heart, and becomes distended and large by the pressure of the blood on the other side of the ligature. Then the distention on the other side, by the coagulum of blood, prevents the approximation of the parietes, and the flaccidity of the coats on the other invites a free deposition of lymph between the coats, and thus does Nature, in her work, provide the means of obliteration, notwithstanding the uncongenial properties of the blood within the vein. All this accords with our experiments upon the vessels in living animals, and we have found that if we merely interrupt the flow of blood through the artery, and irritate the coats so as to produce inflammation, we shall cause the artery to close more slowly and somewhat similar to what we see in the veins, by thickening of the coats, and obliteration without actual adhesion of the inner coats. All of which will be more fully illustrated in the detail of our experiments.

"If a patient be subjected to a great loss of blood at once, or by repeated smaller quantities, we shall have sooner or later an increased volume in the radial artery which would often deceive the most skilful, were he not apprised of the loss of blood. We have heard of such mistakes, and well remember a case where a boy, having wounded an artery in the plantar arch, bled violently from day to day, for about two weeks, notwithstanding a practitioner had used all the usual means of compression. When called to the case we took up the posterior tibial artery, and compression now succeeded in completely arresting the hemorrhage, but, although the patient had lost so much blood as to disable him for four days after the operation, to sit up at all, and although his face was as pale as death, his pulse was full and frequent; and though very compressible when closely attended to, yet, without the greatest attention, one would have supposed there was high excitement.

"That arteries will heal when the blood ceases to circulate through them is a thing universally known, and it is equally well known that this may be effected by compression in various forms—by plugging, tying a mass of fleshy structure around them, by diversion of the blood through other vessels as in the umbilical arteries and their immediate associates, and, also, the ductus arteriosus, etc. So innumerable are the instances of this kind that the opinion of Dr. Jones respecting the necessity of cutting the inner coats of arteries with our ligatures is truly surprising, the more so, as it has obtained the very general approbation of the profession. Among those who have ably aided in refuting this visionary notion may be placed first: A. Burns, and C. Bell; Scarpa, Crampton, and Travers."

It is interesting, in our present knowledge of infections, to quote the following:

"Mr. Travers tells us that Mr. Coleman, a professor in the veterinarian schools in London, assured him that in the horse even small wounds of the skin would seldom heal by the first intention. Our experiments upon animals induce us to believe that the remark of Mr. Coleman will apply to all brute animals upon which we make experiments upon the bloodvessels. Few wounds heal well by the first intention and, indeed, it would seem to be a fair inference to make, *a priori*, that the structure of animals destined to live from one-fourth to one-half of the period allotted to man would be less perfect and less capable of bearing violence done to it than the more complete structure of man. The presumption then is, that, in a vast majority of cases, indeed almost without exception, if we tie an artery, the coats of which are healthy, in a proper manner, it will heal. It will follow then, as our experience has already gone far to prove, that secondary hemorrhage is, in ninety-nine cases in the hundred, owing to bad surgery."

The deduction which he makes upon the character of the ligature are of interest.

"The irritation of a rough ligature, continued a long time about the vessel, together with the attempts which are generally made by surgeons to get away the ligature by pulling, leads to suppuration and erosion of the coats of the vessel. We hesitate not to say that no such consequences will follow the use of the animal ligature, though we would disapprove of tying a nerve where it could be avoided; but we can easily imagine cases in which a surgeon, for want of assistance, might be compelled to dip down a suture needle and enclose muscles, nerves, and everything around, with the bleeding vessel; and we venture to say that perfect safety will attend the use of the animal ligature under such circumstances."

A little prior to Dr. Jameson's studies, the eminent English surgeon, Mr. Lawrence, in the effort to lessen the "irritation" of ligatures upon arteries, brought out his, then, famous teaching that this was to be effected by using the minimum sizes of ligature material. He emphasized by asserting that the ligature best used in the occlusion of a medium-sized artery should not exceed, in weight, a sixtieth of a grain. In criticism of this Dr. Jameson observes:

"Upon the whole we think much credit is due Mr. Lawrance, and some others, for the introduction of the fine silk ligature into practice, since, before the use of the leather ligature, it was certainly a very great improvement; but, at the same time, we must declare, as our opinion, that this ligature was only suited to arteries of moderate size and that when you enlarge the ligature of silk to suit arteries of the first order, it possesses no advantage over the common-flax ligature, since both are alike indissoluble, and indestructible by the absorbents. Here, then, we see the superiority of the leather which, by the time it has answered the purpose of obliterating the vessel, is dissolved by the fluids and enters with them into the absorbing vessels of which we have had actual knowledge. . . . . . . We believe that the animal ligature will secure the patient from all these dangers, except one (to wit), the awkwardness of the surgeon; and even in this respect the animal ligature is preferable, not requiring that precision of management essential to the cutting ligature. If the ligature is cut from the leather with care it will always admit of being tied sufficiently tight, but can never be made to cut the coats, provided it is made of soft buckskin and not hardened by drawing it. It is less likely to slip when somewhat insecurely applied, because being elastic and soft it is spread over a small space of the vessel, and almost immediately adheres by its glutinous qualities; it lies more securely, while the cutting ligature resting on a mere line, and having neither adhesive properties nor the advantage of a small vacuum between the vessel and the ligature, as is the case with the flattish adhesive ligature, is more likely to slip off. Besides, as we cut off the ends close, there is no risk of pulling them away by an "accidental jerk of the hand." In support of these assertions we have to offer the experience of several years' practice, during which we have used no other than the buckskin ligature, and no such thing as a secondary hemorrhage has ever occurred in our practice, extending alike to cases of aneurysm, tumors, and amputations. We are, moreover, decidedly of the opinion that in no case whatever have we had reason to suppose that the healing of a wound, accidental or surgical, was delayed by our ligatures: we never see anything of them after their application."

I quote the following clinical case with deductions by Dr. Jameson, since it shows clearly that he had considered the possibility of closing the wounds made in the veins by sutures for the purpose of preserving their calibre and continuity: "A healthy young man had been wounded in the thigh by a musket ball; at the end of three weeks the femoral artery sloughed, and the patient was only saved from imminent peril by the presence of a surgeon who instantly made pressure. Dr. ——— was called on and immediately proceeded to tie the artery above the profunda, not knowing at that time whether the profunda or femoral was the vessel injured. Two ligatures were applied and the artery divided between them, in doing which the surgeon, instead of putting his knife under and cutting upward, cut from above downward and cut the femoral vein more than half off. There was an alarming hemorrhage from the wound—a sponge was thrust into it without ceremony. About the sixth day he had violent hemorrhage; the gentleman present, not attributing the accident to the right cause, tied the artery higher up, and sagely intimated, when a recurrence of the bleeding from the artery took place, two or three days afterward, that we, who had applied the ligature for the operator had not applied it tight enough. Examination after death, and before any dissection was made, evinced that the limb supposed to edematous, was in reality in a state of mortification. We watched this case throughout its progress, and we feel no hesitation in saying that this patient lost his life in consequence of the division of the femoral vein. How far such a case would admit of remedy is involved in some doubt, but in a similar one we would endeavor to approximate the edges of the vessel by means of a suture or two of fine leather, and, if possible, dress without compression."

Dr. Jameson emphasized the importance of occluding the artery with the minimum damage to the part constricted, in order that he would injure the structure as little as possible by the ligature. He enters into a labored article to refute the teaching of Dr. Jones, to whom is given the credit of the still common practice of applying the ligature sufficiently tight to cause a rupture of the intima.

"We are now prepared to speak of the application of the ligature in cases of amputation. It has been acknowledged, by all surgeons, that common ligatures of silk or flax act as extraneous and irritating bodies in wounds, and hence the practice of cutting off one end. This was attempted to be improved by the fine ligature by Mr. Lawrence, etc.; but though we admit this was an improvement upon the old practice, yet it has not always succeeded; and the fact of its often cutting its way out is a proof of its liability to produce attrition and irritation. We have used the animal ligature in a considerable number of amputations of the limbs, twice in both limbs of the same patients, and in amputation of the mamma. In the latter cases we have, with few exceptions, healed the wounds by the first intention in fourteen or fifteen days; and in the worst cases we have never seen irritation from a ligature, and never more than slight suppurations which delay the healing a few days. In cases of other amputations we have never seen anything of our ligatures; have never had one to slip off, and the stumps heal sooner than when common ligatures are used."

In the following quotation we find he faintly foreshadows the suturing of wounds, and learned by observations that a wound is much less liable to become infected when treated in the so-called open method; in the latter years advocated strenuously by our late friend, Dr. James A. Wood, of New York.

"We have had occasion, in depraved habits, to tie some of the larger veins; we have seen a number of veins pour out blood freely in such habits and have arrested it, by using the crooked needle, by means of which we included in an animal ligature a considerable portion of the surrounding structure, and our experience warrants us in saying that no injury will arise from using an animal ligature in that way, where it may be found necessary. We have never had occasion to open a stump on account of hemorrhage; such a thing, we believe, never having occurred where an animal ligature was well applied, and we have never known one applied otherwise. The other circumstance, to which we alluded, is that of exposing cut surfaces freely to the atmospheric air and never being in too much hurry in closing surgical wounds. For this we are indebted to J. Bell. We not only wait until the blood coagulated well over the face of the stump, but until there is a degree of action restored to the arterial system; about half an hour may be considered the proper time."

Dr. Jameson's opinion upon the application of the ligature in cases of wounds of arteries is of present interest, especially in the light of very recent observations upon the aseptic closure of wounds of large arteries by means of sutures. His deduction is that the ligature should be used at once rather than trusting to means of compression.

"*Of the Application of the Ligature in Cases of Wounds.* In the first lines of S. Cooper (152), reference is made to the experiments of Jones and Blecard, which were intended to prove that wounds of small dimensions, in large arteries, will heal without obliteration of the vessels. Mr. Cooper has, however, very properly remarked that it is a point settled by dissections, that no artery, wounded, and healed under pressure will remain pervious. These experiments, therefore, afford nothing applicable to practice. To trust a wounded artery to nature or to attempt the application of sutures with a view of closing such wounds will never be justified in the human body, and to attempt to close such wounds by compression, if the injured vessel be of considerable size, is to incur the risk of disappointment and danger which may be avoided by the application of the ligature."

In an illustration I quote further from his experience: "We had a patient who had his forearm torn by a large stone falling on it; the radial artery was denuded and appeared much contused in fully an inch and a half of its length. The sheath was split up about three-fourths of an inch and an animal ligature applied to the sound artery, and the lower portion managed in the same manner. All that portion of the artery visibly injured was removed, as also all the contused cellular tissue. The wound, which was nearly in the longitudinal direction of the arm, was now carefully closed by adhesive plaster. Nothing was ever seen of the ligatures and nearly the whole of the wound healed by the first intention—a little pus issuing, for a few days, from the lower angle of the wound, the outer or superficial part of which closed before the first dressing. We also saw a case where, by the bursting of a gun, a large wound was made in the forearm by some part of the fragments. The artery was torn off and bled freely. The patient, however, by grasping the parts firmly was enabled, by the favorable course of the wound nearly in the direction of the radius but somewhat spiral, to prevent immediate death. A physician of experience in the neighborhood applied, shortly afterward, a tourniquet. When we arrived we dissected the artery clean, until satisfied of having a sound part, an animal ligature being applied and the tourniquet loosened. The lower portion together with two anomalous branches about half an inch apart, and the first as far from the radial, bled furiously. These were tied with the animal ligature; the injured artery and cellular structure were removed by the scalpel. The parts carefully brought together by adhesive plaster healed in much the greater part by the first intention, although the wound was contused and lacerated so that we had no expectations of such a result The ligatures were never seen nor was there any pus from the wound. . . . . . As a general rule, it may be said that, where we tie an artery that is wounded, we should apply two ligatures; but we have no hesitation in saying that if the animal ligature be used there is no advantage whatever in dividing the vessel between the ligatures. If there be severe contusion, which is likely to lead to sloughing, we should treat the contused part as we would those around; if much bruised cut them out."

In a further criticism of forceful ligation of arteries Dr. Jameson quotes the practice of Scarpa, which very naturally he criticizes, although he considers the practice superior to that of Dr. Jones, before referred to, who insisted upon the division of the interior coat of the vessel.

"We are not able, precisely, to state the views of Dr. Physick[1] upon this subject, but to him is certainly due the merit of introducing the animal ligature into practice. We will endeavor to do the doctor justice; if we fail in it, it shall not be wilful. We have been creditably informed that Dr. Dorsey, acting under the auspices of Dr. Physick, was in the habit of cutting his ligatures from chamois leather, and rolling them on a slab to make them round. This, to us, is a clear proof that Dr. Dorsey, at least, did not coincide with Scarpa in opinion, but with Jones. And we know experimentally, whatever may have been the theory of those gentlemen, that a leather ligature rendered hard by rolling, or close drawing through our nails, is liable, if applied tight, to cut the inner coats. This practice, therefore, was not suited to the views of Scarpa, Crampton, etc.

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[1] Philip S. Physick, born 1768, died 1837. Student of John Hunter

"If we are right in the opinion which we have just expressed, Dr. Physick is entitled to the credit of bringing into use the best ligature, as to the material, but here his claim is at an end. The following results seem to have been attained: The experiments of Hunter and Jones show the importance of the vasa vasorum, and consequently the advantage of leaving arteries to be tied, as much as possible, *in situ*. Scarpa and his associates, in opinion, have shown the superiority of the method of applying ligatures which will not cut nor bruise the coats of the artery; and the advantage of removing them before the suppurative inflammation is produced by their presence. Dr. Physick and Sir Astley Cooper have shown the advantages of using a substance which will serve as a ligature until the artery is obliterated, and be speedily afterward in the power of the absorbents so that they will remove it. Now, in the practice of Hunter and Jones, although they were aware of the importance of preserving the vasa vasorum, yet, we see them cutting off the true vasa vasorum and relying chiefly on the vessels subsidiary to them. The disadvantages of this method, then, are that they weaken the arterial coats, destroy the circulation in the true vasa vasorum, and thus produce too much inflammation. This method will nevertheless succeed very well in vessels of moderate size, but in the larger arteries it will not, because large vessels when tied fall into puckers, the coats are cut irregularly, the cellular coat is too weak to confine the tissue arterial, and consequently its elastic power will raise some of the cut folds above the ligature, drawing the yielding external coat with it; the sides of the vessel between the ligature and the heart will not be in contact, no union will take place, and secondary hemorrhage will, sooner or later, follow the use of such a ligature. We have two cases in point: those of Dr. Mott and Dr. Graeffe, upon the arteria innominata. In the practice of Scarpa and others, pointed out above, all the objections to that of Jones are avoided, hence the preference of the former over the latter. But strong objections grow out of the circumstance that we cannot heal the wound by the first intention. On the fourth day we are to cut the ligature and remove it. This part of Scarpa's practice is exceedingly objectionable because the wound must be kept open, and to effect this we must often introduce some extraneous body into the wound to prevent its healing before the fourth day; and no dexterity of the surgeon, nor ingenuity in the construction of an instrument to effect this purpose, can be devised which will obviate considerable pain to the patient, and perplexity and apprehension to the surgeon in cutting the ligature. We have cut for the femoral artery in a patient in whom there was fully one inch of fat over the artery; in such, and similar cases, there would be much difficulty in cutting a ligature.

"A decided preference must be allowed to the method of Physick and Cooper, as it involves facts and principles which free it from all the objections to which the methods of Jones and Scarpa are liable. But, notwithstanding the facts and prinicples afforded by these celebrated men, they have left the subject susceptible of improvement; and to point out, and establish upon substantial and solid ground, some material improvement in this department of surgery has been the chief aim and design of this essay.

"We will now proceed to point out our own views and endeavor to support them by experiment.

"1. We believe that if an artery is sufficiently healthy to admit of its obliteration by adhesion of its sides, it is best done by a ligature which will neither cut its coats nor strangulate, except in parts, the true vasa vasorum, so that the continuity of the vessel shall not be destroyed although we obliterate its calibre.

" 2. We believe that if an animal ligature of the proper kind be properly applied, the vessel will be obliterated, the wound may be healed by the first intention, and the ligature will not cause suppurative inflammation; but in due time, being dissoluble, the whole will be removed by the absorbents. There will be no breach of continuity in the artery, the materia arteriarum will be removed, and the vessel, which during the state of inflammation and effusion of lymph was converted into a cord, will very soon afterward be resolved into a flat string of white cellular structure.

" EXPERIMENT I.—The carotid artery of a sheep was laid bare, and a common suture needle was passed through the artery armed with a tapering ligature the largest end of which was about three lines in width and its thickness that of very thick buckskin. It was cautiously drawn through nearly to the largest end, both ends were then cut off about three lines from the vessel; not a drop of blood escaped. The animal was killed, twenty-two days after the experiment, in good health. The artery was greatly thickened in its coats about an inch above and below the seton. No traces of a wound could be seen on one side of the artery; on the other side there was a slight depression in which lay a little yellowish matter, but which on examination proved to be a small part of the buckskin remaining within the vessel and reduced to a pulp by its mixture with a portion of lymph. The sides of the vessel were closely in contact but not quite united; a flattish opening was seen, through which a very small probe might have been passed. There is no doubt that this vessel, which was thus gradually contracted in its calibre, would in a short time have been quite obliterated, and we are quite certain no blood circulated through it at the time the animal was killed.

"EXPERIMENT II.—The jugular vein of a sheep was surrounded by an animal ligature, rendered firm by drawing it, after cut from the skin: at the end of six days the animal was killed. The ligature was still around the vessel, but upon scraping it gently with a knife the skin was found as thin as tissue paper. The vein lay in puckers or plaits within and there was no union of the coats under the ligature. Above the ligature the vessel was inflamed and distended by a coagulum which adhered to its sides, and was about two inches long. The vein became thickened a little below the ligature and assumed the size of the vein when distended with its blood, but was solid. When cut across it had the appearance of a transverse section of the human esophagus; though traces of its calibre could be seen, yet it would not admit the end of a small blow-pipe. No pus in any part, but lymph still exuding. In short, the vessel was completely obliterated without union of its sides, but by thickening of the coats, as represented by Mr. Travers. It is evident here there would have been no breach of continuity of the vein, and in a few days the small remains of the ligature would have been removed.

"EXPERIMENT III.—The left carotid of a dog was laid bare and transfixed with a buckskin string, as in experiment I. The animal continued playful and although there was considerable swelling of the throat it ate well every day. This animal was killed on the twenty-fifth day after the operation; no traces of violence remained in the parts until we came down upon the artery, which was slightly contracted, somewhat thickened, and hardened in its coats. Small red dots were seen here and there within the artery, and on the side next the heart the inner coat was a little fuzzy. On either side of the vessel were seen two little yellow knobs, which proved to be the two ends of the ligature, in the state of yellow pulp. The knobs were completely enveloped in a strong membraneous capsule; the same capsule enclosed both knobs, and its fibers were plainly seen crossing over the artery. This arrangement of the capsule seemed to have the effect of drawing the button-like knobs together and was thus closing the vessel. If any circulation had remained it must have been very little, as the artery was so contracted just where the string passed through it as to be in contact with the inside coat of the artery. On the lower side, where the coats were not cut in splitting open the vessel to examine its interior, there was an actual adhesion of the leather to the inner coat. The string was softened into a pulpy consistency, and near the inside of the vessel was evidently covered with organized lymph, and extending along its edge at one side some distance. When the string was gently pulled one plainly saw a delicate membrane passing off from the artery and ending on the string in fringed extremities. This attachment of the vessel, by a new formation, existed on both sides of the artery and also at its inner and outer sides. The capsule covering the knobs or ends of the string was fully equal in strength to the outer coat of the artery and, therefore, there was no tendency to hemorrhage.

" Experiment IV.—We tied the left carotid low down in a sheep; at this part the vessel lay deep and a good deal of violence was done to the parts before the artery was fully exposed. It was detached from its connections about an inch and a half. This animal was extremely wild, seemed unwell, and would not eat freely before operated on, and scarcely at all after. An animal ligature was applied tight. On the sixth day this animal died; the parts were in a state of gangrene and, therefore, little information is to be had from our examination.

We remarked that the ligature was very tight, and had cut the inner coats nearly all round; no adhesion had taken place. We cite this case to show that a *drawn* buckskin ligature will cut the inner coats, and to show that where the inflammation runs too high for the production of lymph the ligature will not readily dissolve.

" Experiment V.—We exposed the jugular vein of a sheep, which was unusually large, say three-fourths of an inch in diameter. A tapering string of soft buckskin was passed through it as in experiment I. At the end of six days this animal, being the subject of experiment IV, died. On examination the vein was affected with gangrenous inflammation, but had contracted at least two-thirds of its size where transfixed. Some lymph, of a reddish color, surrounded the ligature, giving it much the appearance of a pulpy mass of flesh. The sides of the vein closely embraced the leather, and there were plainly to be seen, inside of the vein, membraneous shreds passing off along the string. This vessel would doubtless have been obliterated, and no risk of hemorrhage existed.

"EXPERIMENT VI.—We tied the jugular vein of a dog with a drawn animal ligature. At the end of nine days the animal was killed and the following appearances presented, the animal not having been sensibly injuried in its health: The vein immediately below the ligature, though somewhat puckered, was healed by adhesion of the inner coat according to the views of Dr. Hunter; above and below, for nearly an inch, the coats were greatly thickened. The inner coats were divided and the two ends of the vein separated more than half an inch. There was no coagulum on either side of the ligature, nor any appearance of inflammation. About half an inch of the vessel, on both sides of the ligature, was greatly thickened. The ligature below the vein was completely removed, and a pulpy, yellowish, little, button-like fragment of the ligature remained on either side of the vessel, but detached from each other and surrounded by a quantity of lymph; no appearance of pus. The parts around were not inflamed nor diseased. The appearances in this case exactly resembled the drawing in Mr. Travers' thirteenth plate.

"EXPERIMENT VII.—The superficial femoral artery of a sheep, a vessel about the size of a crow quill, was dissected up a small distance and torn out. The animal did not seem to mind it; there was but two or three teaspoonfuls of blood. We found this artery contracted much more than a dead artery, and it had a sort of writhing motion when handled, convincing us of its vitality. When examined after the death of the animal, the artery was filled by a coagulum about an inch long, and it was contracted and hard like the vas deferens; the cellular tissue around it somewhat injected with blood, but not so much as to produce any pressure upon the artery.

" EXPERIMENT VIII.—A number of experiments were made upon a dog which had been bled to death the day before; ligatures of various kinds were applied from just below the arch of the aorta to near the iliacs, and the following results were obtained:

" 1. Ligatures of four common coarse sewing threads, twisted slightly into a cord, would not cut the inner coats.

" 2. Ligatures of two threads applied tightly not only cut the coats entirely around, leaving nothing but the thin outer coat, but by cutting the vasa vasorum a small portion of blood escaped and formed a red line which appeared on removing the ligature.

" 3. Buckskin ligatures of common size, *drawn through the nails of the thumb and forefinger,* cut the coats more or less.

" 4. A flattish ligature *about two lines in width, not drawn through the nails but applied tight,* neither cut nor bruised the inner coats.

" 5. Ligatures of buckskin of common size, *not drawn, applied gently,* did not cut the inner coats. But all kinds of the leather ligatures could be applied, with care, tight enough to bring the sides of the artery into contact without cutting the coats. In every instance the vessel was much puckered, but still the sides in all cases lay pretty well in contact, but when tied with the cutting ligature were no better than when they did not cut. Indeed we thought there was a preference, in this respect, in favor of the soft animal ligature loosely applied. We have practised these experiments upon the large arteries of human subjects and find no difference, except that the coats of the human kind do not so readily give under the animal ligature, and with any tolerable prudence in the application they will not cut the inner coats at all.

"We trust we may now venture to assert that we have arrived at the following important conclusions: (1) Hunter and Jones were right in advising us to take care of the vasa vasorum; (2) Scarpa, Crampton, Travers, etc., were right in objecting to cutting the *tissue arterial;* they did not succeed, however, in devising the proper means of securing the intention of obliterating vessels without destroying their continuity; (3) Physick and Cooper, by employing a ligature having the property of dissolubility, greatly improved our practice, whatever might have been their theory. Physick's ligatures, first used in 1814, have done much good. Cooper by tying, in 1817, the femoral artery of a man aged eighty years, and healing the wound by the fourth day, shows the superiority of this method over that of Scarpa.

"We aim at a combination of the improvements of all these parties; we say, do not disturb the vessels subsidiary to the vasa vasorum; do not cut off the true vasa vasorum nor strangulate them by your ligature. Tie the artery with a very soft buckskin ligature, and a little broader than the thickness of the skin; take care not to tie it too tight. Having done this you may expect that the wound, in many cases, will heal by the first intention; where this fails there will be no suppuration about the vessel and the wound will close very soon. You may expect a capsula to surround your ligature if you have not disturbed the capillary vessels more than can be avoided, or the vessel will be surrounded by an abundance of lymph and the ligature dissolved.

"In support of the above declaration we have to offer, in addition to the foregoing experiments, the following results of our surgical practice: We have used the animal ligature for six or seven years; we have used it in many amputations of the limbs and of the mamma; we have once tied the carotid; once the external iliac; twice the femoral; four times the radial; once the posterior tibial; seven times the spermatic; and in no instance have we ever had secondary hemorrhage; never have we had a ligature to slip; we have never seen anything of our ligatures after their application, and often, indeed generally, our wounds have healed by the first intention. . . . . In cases of amputation we believe that no ligature will bear a comparison with one of soft buckskin, of moderate thickness, cut from the skin about twice as wide as thick, and drawn between the nails of the thumb and forefinger so as to make it more solid, but it should never be made round; this would cause it to cut the coats, make it less dissoluble, and more apt to slip off, all of which we ascertained by actual experiment."

In conclusion, it is interesting to note that Dr. Jameson was decidedly opposed to the then common habit of a reduced regimen by the use of calomel and other cathartics, a rigid diet, etc., and he totally forbids the use of all spirituous drinks of every kind, at that time considered a *sine qua non.* He concludes by saying: "We must content ourselves, here insisting upon the facts, whatever may be thought of our theories."

Thus it will be seen that to Physick, of Philadelphia, who about 1814 first used the animal ligature, and to Jameson, of Baltimore, are due this innovation in surgery, the practice of which is now in daily use on both continents. We trust the time is not far distant when proper honor may be accredited to these two great men and through them to American surgery. They laid the foundations for the introduction and use of the absorbable animal suture which now justly holds a first place in modern aseptic surgery.

In this connection I am sure it will be *apropos* to refer briefly to my own experience in the use of absorbable ligatures and sutures.

It was my good fortune to be the special pupil of Mr. Lister in 1869. He had only recently introduced the animal ligature for the occlusion of vessels in surgery. This was based upon original studies which, owing to the laws of England, he was obliged to resort to the Continent to carry into effect. His inspiration grew out of his studies of Pasteur's demonstrations of the laws governing fermentation; that it was a vital and not, as Liebig had declared, a chemical process.

If vital, why not the explanation of the hitherto unknown vexed problem of wound inflammation? Out of this grew, as you all know, the choice of catgut rendered antiseptic by steping in carbolic acid. His experiments duplicated and his results paralleled, in very large measure, those of Dr. Jameson, although I have every reason to believe that Mr. Lister was entirely ignorant of them. Mr. Lister had never used buried animal sutures, although he had often called my attention to the fact that a through-and-through stitch tied in the usual manner, in the processes of primary union, was frequently separated in the deeper layer of the skin, leaving the lower portion of the loop permanently buried. To me it seemed a logical deduction that the tissues could be coapted safely by buried sutures, the changes resulting in and about the suture going on precisely as when placed to include only a vessel. The results of my studies were first published in 1870, followed by many subsequent publications which are now well known. For very many reasons the sutures from the tendons of animals, especially those from the tail of the kangaroo, are preferable to catgut.

Long-continued careful, experimental, research work upon the lower animals enabled me to thoroughly demonstrate that the aseptic animal connective tissue, whatsoever its special character, whether applied for the constriction of vessels or used as sutures for the coaptation of well-vitalized structures, was first surrounded by leukocytes. These slowly invade the foreign material and, *pari passu,* as absorption takes place, they are transformed into connective-tissue cells, largely replacing the suture material. Thus there results a living band, more or less permanently replacing the suture material. Such reinforcement of the structures, after many operations as for example hernia, has been proven to be of great practical importance. The change of a well-established custom or practice is necessarily slow, but one ventures little in the assertion that the absorbable animal ligature and suture will retain a permanent place in surgery.

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